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VOL. XV.] DECEMBER, 1924. [No. 4.

The Innervation of the Sensory Cells of the *Macula Acustica* in the Rat.*

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THE auditory organ in vertebrates serves two distinct functions: (1) that of the perception of sound waves by the sensory cells of the organ of Corti; and (2) that of the maintenance of equilibrium through the instrumentality of sensory cells collected in certain groups constituting the so-called *maculæ* and *cristæ acusticæ*. The maculæ are small areas in the utricular and saccular portions of the membranous labyrinth, while the cristæ are elongated areas in the ampullæ of the semicircular canals. The cells constituting the maculæ and the cristæ have been studied in the past by various methods at the hands of Retzius, von Lenhossek and others, but with results not altogether satisfactory.

Perhaps the most definite account of these structures and their innervation in mammals is that of von Lenhossek (*Beiträge zur Histologie des Nervensystems und der Sinnesorgane;* Wiesbaden, 1894). His figure of the *macula acustica sacculi* of the mouse, from material prepared by the Golgi method, is that most frequently copied in various recent textbooks of histology, and represents the best of our knowledge heretofore available on this matter. This figure, redrawn from Dahlgren and Kepner's "Principles of Animal Histology," is reproduced here (Plate XXV, Fig. 1). It gives a typical Golgi picture—the uneven, knotted and twisted deposits of silver supposedly representing the nerve fibers as they pass through the basement membrane and divide to send similarly knotted and knarled

* This is the substance of a paper read before the American Society of Mammalogists, at its third annual meeting, in Washington, D. C., on May 3, 1921. See *Journal of Mammalogy*, vol. 2, No. 3, August, 1921, p. 185.

branches toward the sensory cells. Particular attention may be called to the strands of silver deposited along the sides of these sensory cells, and also to certain shorter branches extending downward toward the basement membrane. Valuable as the Golgi method has been and still is in revealing the structure of the nervous system, it is so uncertain in its results and so unreliable in giving a true picture of what it is intended to reveal that it is necessary to check the results of this method by others differing from it in principle.

In Plate XXV, Figure 2, is presented a view of the relation of the nerve endings to the sensory cells of the macula acustica in the rat, apparently very different from that shown in von Lenhossek's figure. It is evident that this view only completes the representation of the structures merely hinted at by the Golgi preparation. The material was obtained from a freshly killed five-day-old rat and was prepared by the well-known pyridine method of Ranson and Huber.

This preparation obviously gives a more complete picture of the actual structures present and shows that the sensory (hair) cells of the macula are surrounded by a palisade of fibers, derived from the vestibular nerve, which extend well up on all sides of these cells, so that no matter in what direction the head may be turned there is a nerve ending to receive the stimulus. These sensory cells and their surrounding nerve fibers are supported by a series of non-sensory cells resting upon a basement membrane, while the distal ends of both the sensory and the supporting cells are bounded by a cuticular or "cribriform" membrane, through the perforations in which extend the long, stiff, so-called "auditory" hairs into the cavity of the membranous labyrinth. The term "auditory" is so clearly a misnomer here that it is preferable to designate these structures merely as "sensory processes." These sensory processes are in life imbedded in a soft mucuslike substance that flows freely enough in response to changes in posture to stimulate the sensory cells through which the impulse is transferred to the proper adjacent nerve ending.

EXPLANATION OF PLATE XXV.

FIG. 1. Redrawn from Dahlgren and Kepner's "Principles of Animal Histology"; it is von Lenhossek's figure of the innervation of the *macula acustica sacculi* of the mouse as revealed by the Golgi method of preparation.

FIG. 2. A semidiagrammatic representation of the same structure in the young rat as revealed by the pyridine method of Ranson and Huber. The sensory cells are shown surrounded with a "plisade" of nerve fibers.

PLATE XXV.

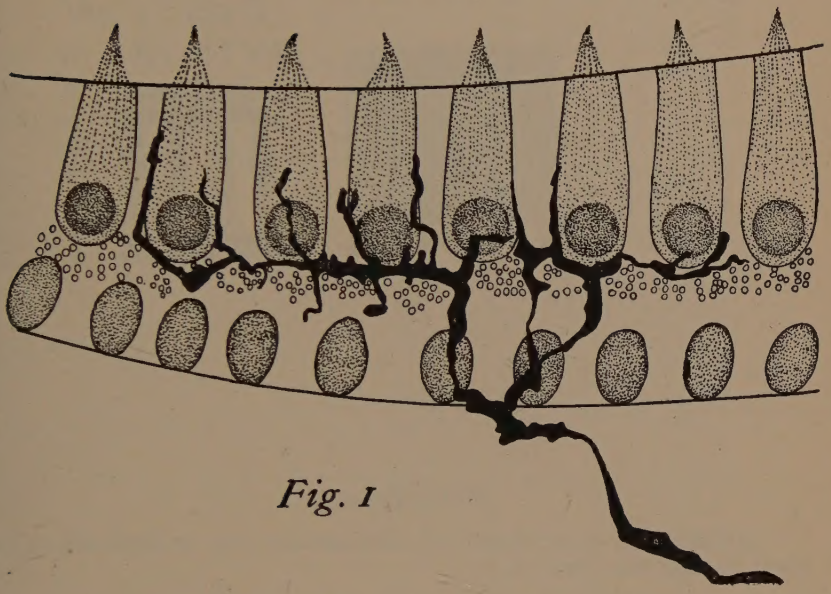

Fig. 1

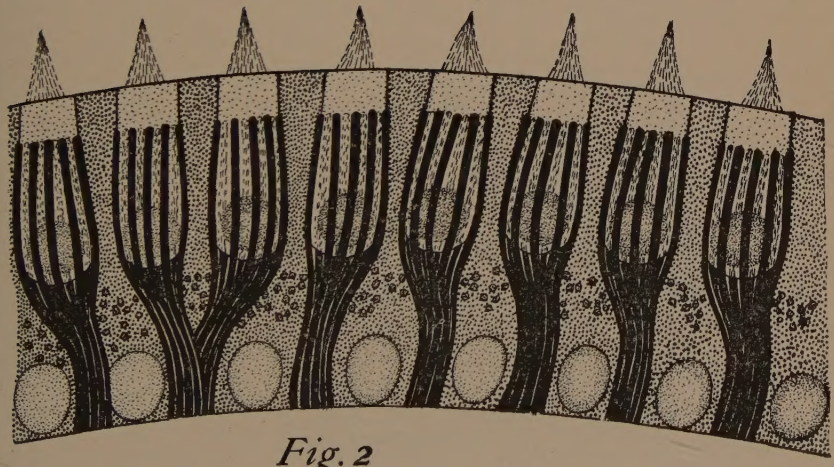

Fig. 2